

SCIENCE

NEW YORK, FEBRUARY 27, 1891.

SUGGESTION IN INFANCY.¹

THE rise of hypnotism in late years has opened the way to an entirely new method of mental study. The doctrine of pure reflexes was before largely physiological, and only pathological cases could be cited in evidence of a mechanism in certain forms of consciousness as well as out of it; and even pathological cases of extreme sensitiveness to casual suggestion from the environment or from other men did not receive the interpretation which the phenomena of hypnotic suggestion are now making possible, i.e., that suggestion by idea, or through consciousness, must be recognized as as fundamental a kind of motor stimulus as the direct excitation of a sense-organ: in other words, *that nervous reflexes work directly through states of consciousness; that the latter are integral portions of these reflexes*; and, further, *that a large part of our mental life is made up of a mass of such ideo-motor reflexes, which are normally in a state of subconscious inhibition.*

Without discussing the nature of the hypnotic state, nor venturing to pass judgment in this connection upon the question whether the suggestion theory is sufficient to explain all the facts, we may yet isolate the aspect spoken of above, and discuss its general bearings. Of course, the question at once occurs, is the normal life a life to any degree of ideo-motor or suggestive re-actions, or is the hypnotic sleep in this aspect of it quite an artificial thing? Further, if such suggestion is normal or typical in the mental life, what is the nature of the inhibition by which it is kept under? Leaving this second question altogether unanswered for the present, it has occurred to me to observe my child² during her first year to see if light could be thrown upon the first inquiry above. If it be true that ideo-motor suggestion is a normal thing, then early child-life should present the most striking analogies to the hypnotic state in this essential respect. This is a field that has hitherto, as far as I know, been almost untouched by psychologists.

Observation of re-actions clearly due to suggestion in my child, either under natural conditions or by experiment, lead me to distinguish the following kinds of suggestion, mentioned in the order of their appearance in child-life:—

Suggestion	{	Physiological	{	Deliberative	
		Sensori-motor			Imitative
		Ideo-motor			

I shall proceed by first describing the class of phenomena designated, and then the evidence, small or great, which my observations afford in each case.

1. *Physiological Suggestion.*—By “suggestion” ordinarily is understood ideal or ideo-motor suggestion,—the

¹ For the general facts and interesting treatment of the movements of infants, see Preyer's *Senses and Will*, part ii.

² Called hereafter simply H.

origination from without of a motor re-action by producing in consciousness the state which is ordinarily antecedent to that re-action. But observation of an infant for the first month or six weeks of its life leads to the conviction that its life is mainly physiological. The vacancy of consciousness as regards any thing not immediately given as sensation, principally pleasure and pain, precludes the possibility of ideal suggestion as such. The infant at this age has no ideas in the sense of distinct memory-images. Conscious states are affective. Accordingly, when the re-actions which are purely reflex, and certain random impulsive movements, are excluded, we seem to exhaust the contents of consciousness.

Yet even at this remarkably early stage H. was found to be in a degree receptive of suggestion—suggestion conveyed by repeated stimulation under uniform conditions. In the first place, the suggestions of sleep began to tell upon her before the end of the second month. Her nurse put her to sleep by laying her face-down and patting gently upon the end of her spine. This position soon became itself not only suggestive to the child of sleep, but sometimes necessary to sleep, even when she was laid across the nurse's lap in what seemed to be an uncomfortable position.

This illustrates what I mean by physiological suggestion. It is the law of physiological habit as it borders on the conscious. No doubt some such effect would be produced by pure habit apart from consciousness; but, consciousness being present, its nascent indefinite states may be supposed to have a quality of suggestiveness, which indicates the degree of fixedness of the habit. Yet the fact of such a coloring of consciousness in connection with the growth of physiological habit is important more as a transition to more evident suggestion.

The same kind of phenomena appear also in adult life. Positions given to the limbs of a sleeper lead to movements ordinarily associated with these positions. The sleeper defends himself, withdraws himself from cold, etc. All secondary automatic re-actions may be classed here, the sensations coming from one re-action (in, say, walking) being suggestions to the next movement unconsciously acted upon. The state of consciousness at any stage, if present at all, must be similar to the baby's in the case above,—a mere internal glimmering, whose reproduction, however brought about, re-enforces its appropriate re-action.

The most we can say of such physiological suggestion is, that, when the conscious state is present, the re-action is subsequently abbreviated and facilitated; but whether abbreviation is due entirely to habit, and the consciousness is only a result of such abbreviation, not its cause, we are unable to say.

The physiological process involved, and its relation to consciousness, may be brought out by a diagram; but, in order that it and those which follow may be easily understood, it may be well to present the *motor square*, as we

may call it (Fig. 1), which contains all the elements of the phenomena of suggestion, and of which the special diagrams below are modifications.

Each corner indicates a physiological process with or without consciousness, as follows: *sg* = suggestion (sensory); *mp* = seat of motor process; *mt* = movement of muscle; *mc* = consciousness of movement. The sides of the square are connections between the seats of these processes. A cross (X) in any corner indicates that the brain process alone is intended at that seat; a circle (O), that consciousness at that seat is intended.

The stimulus *sg* (Fig. 2) starts the motor process *mp*: it leads to movement, *mt*, which is reported to consciousness,

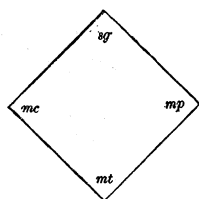


FIG. 1.—MOTOR SQUARE.

mc. The line between *sg* and *mc* is broken, because at this stage in infancy associations are just beginning to be formed between a feeling of muscular movement and its stimulating sensation.

2. *Sensori-Motor Suggestion*.—These cases of suggestion may be classed somewhat in this way:—

(a) *Various Sleep Suggestions*.—From the first month on, there was a deepening of the hold upon her of the early method of inducing sleep. The nurse, in the mean time, added two nursery rhymes. Thus position, pats, and rhyme sounds were the suggesting stimuli. Not until the third month, however, was there any difference noticed, when the same suggestions came from other persons. I myself learned, during the fourth month, to put her to sleep, and

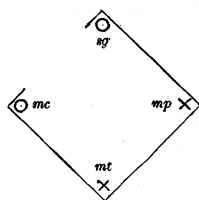


FIG. 2.—PHYSIOLOGICAL SUGGESTION.

learned with great difficulty, though pursuing the nurse's method as nearly as possible. Here, therefore, was a sleep suggestion from the *personality* of the nurse,—her peculiar voice, touch, etc. At this time I assumed exclusive charge of putting H. to sleep in order to observe the phenomena more closely. For a month or six weeks I made regular improvement, reducing the time required from three-quarters of an hour to half an hour, finding it easier at night than at mid-day. This indicated that darkness had already become an additional sleep suggestion, probably because it shut out the whole class of sensations from sight, thus reducing the attention to stimuli which were monotonous. I found by accident, in this connection, the remarkable fact that a single flash of bright light would often put H. immediately to sleep

when all other processes were futile. In her fifth month I despaired one evening, after nearly an hour's vain effort, and lighted the gas at a brilliant flash unintentionally. She closed her eyes by the usual reflex, and did not open them again, sleeping soundly and long. I afterwards resorted to this method on several occasions, carefully shielding her eyes from the direct light-rays, and it generally, but not always, succeeded. I would like to know if this experience is shared by nurses or other parents. In the following month (sixth) I reduced the time required (day or night) to about a quarter of an hour, on an average. In this way I found it possible to send her off to sleep at any hour of the night that she might wake and cry out.

I then determined to omit the patting and endeavor to bring on sleep by singing only. The time was at first lengthened, then greatly shortened. I now found it possible (sixth to seventh month) to put her to sleep, when she waked in the dark, by a simple refrain repeated monotonously two or three times. In the mean time she was developing active attention, and resisted all endeavors of her nurse and mother (who had been separated from her through illness) very stubbornly for hours, while she would go to sleep for myself, even when most restless, in from fifteen to thirty minutes. This result required sometimes firm holding-down of the infant and a determined expression of countenance.

At the end of the year, this treatment being regular, she would voluntarily throw herself in the old position at a single word from me, and go to sleep, if patted alone uniformly, in from four to ten minutes. This continues to the present (sixteenth month); even when she is so restless that her nurse is unable to keep her from gaining her feet, and when she screams if forced by her to lie down. The sight only of myself makes her entirely quiet; and in, say, five minutes, rarely more, she is sound asleep. I found it of service, when she was teething and in pain, to be able thus to give her quiet, healthful sleep.

This illustrates, I think, as conclusively as could be desired, the passage of purely physiological over into sensory suggestion; and this is all that I care, in this connection, to emphasize. The explanation, as I believe, throws light upon the theory of the rise of volition; but that aspect of it may be left for future discussion.

(b) *Food and Clothing Suggestion*.—H. gave unmistakable signs of response to the sight of her food-bottle as early, at least, as the fourth month, probably a fortnight earlier. The re-actions were a kind of general movement toward the bottle, especially with the hands, a brightening of the face, and crowing sounds. It is curious that the rubber on the bottle seemed to be the point of identification, the bottle being generally not responded to when the rubber was removed. The sight of the bottle, also, was suggestive much earlier than the touch of it with her hands.

She began to show a vague sense of the use of her articles of clothing about the fifth month, responding at the proper time, when being clothed, by ducking her head, extending her hand or withdrawing it. About this time she also showed signs of joy at the appearance of her mittens, hood, and cloak, before going out.

(c) *Suggestions of Personality*.—It was a poet, no doubt, who first informed us that the infant inherits a peculiar sensibility for its mother's face,—a readiness to answer it

with a smile. This is all poetic fancy. When the child does begin to show partiality for mother or nurse, it is because the kind treatment it has already experienced in connection with the face has already brought out the same smile before; the mother's face, that is, grows to suggest the smile. At first it is not the face alone, but the personality, the *presence*, to which the child responds; and of more special suggestion, the voice is first effectual, then touch (as in sleep above), and then sight. Such suggestions are among the most important of infancy, serving as important elements in the growth of the consciousness of self and of external reality; but such considerations are not pertinent to the present connection. Without delaying longer on this class of suggestions, the question occurs, are we not here simply observing cases of the association of ideas? I think we are warranted in answering, "No!" most emphatically, for the reason that it is not an associated idea that is brought up. It is a muscular movement that is produced, without the production of an idea of that movement. Can we say that the sleep suggestions first bring up an idea or image of the sleep condition, or that the bottle brings up an idea of the movements of grasping, or even of the sweet taste? No, the case is more direct. The energy of stimulation passes over into the motor re-action through the medium of the

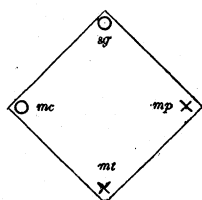


FIG. 3.—SENSORY-MOTOR SUGGESTION.

conscious state. Further, as will appear clearer below, it is not an association plus a suggestion, or an association plus an association, as current doctrines of motor-stimulation would lead us to expect. We cannot say that pleasure or pain always intervenes between the present state of consciousness and the motor re-action; i.e., mother's face, pleasure recalled, expression of pleasure, or present bottle, sweet taste, movements to reach. I believe all this is quite artificial and unnatural,—a point to which the remainder of this paper will put in clear relief.

The explanation is as before for physiological suggestion, except that the re-action begins with a conscious process (O) at *sg* (Fig. 3), and the child is getting associations between *sg* and *mc*.

3. *Deliberative Suggestion.*—By "deliberative suggestion" I mean a state of mind in which such co-ordinate stimuli meet, affront, oppose, further, one another. Yet I do not mean "deliberation" in the full-blown volitional sense; but *suggestion* that appears deliberative, while still inside the re-active consciousness. It lacks self-consciousness, self-decision, self in any form. The last three months of the child's (H.'s) first year are, I think, clearly given over to this kind of consciousness. Motor stimulations have multiplied, the emotional life is budding forth in a variety of promising traits, the material of conscious character is present; but the "ribs" of mental structure may still be seen

through, re-active couples, response answering to appeal in a complex but yet mechanical way.

As an illustration of what I mean, I may record the following case of deliberative suggestion from H.'s thirteenth month: it was more instructive to me than whole books would be on the theory of the conflict of impulses. When about eight months old, H. formed a peculiar habit of suddenly scratching the face of her nurse or mother with her nails. It became fixed in her memory, probably because of the unusual facial expression of pain, reproof, etc., which followed it, until the close proximity of any one's face was a strong suggestion to her to give it a violent scratch. In order to break up this habit, I began to punish her by taking the hand with which she scratched at once, and snapping her fingers with my own first-finger hard enough to be painful. For about four weeks this seemed to have no effect, probably because I only saw her a small portion of the time, and only then did she suffer the punishment. But I then observed, and those who were with her most reported, that she only scratched once at a time, and grew very solemn and quiet for some moments afterwards, as if thinking deeply. And soon after, this climax was reached: she would scratch once impulsively, be punished, and weep profusely, then become as grave as a deacon, looking me in the face. I would then deliberately put my cheek very close to her, and she would sit gazing at it in "deep thought" for two or even three minutes, hardly moving a muscle the whole time, and then either suddenly scratch and be punished again, or turn to something (noise or object, watch-chain, etc.) near by. Having scratched, she began to cry in anticipation of the punishment. Gradually the scratching became more rare. She seldom yielded to the temptation after being punished, and so the habit entirely disappeared. I may add that her mother and myself endeavored to induce a different re-action by taking the child's other hand and gently stroking the face which she had scratched. This movement in time replaced the other completely, and now the soft stroking has become one of her most spontaneous expressions of affection.

Now, the interpretation is this, in terms of the foregoing pages: the first act of scratching was probably accidental, one of the spontaneous re-actions or physiological suggestions so common with an infant's hands; it passed, by reason of its peculiar associations, into a sensori-motor re-action whenever the presence of a face acted as suggestion,—so far, a strong direct stimulus to the motor centres. Then came the pain,—a stimulus, both direct and associative, to the inhibition of the foregoing. For a time the former was too strong; then there followed an apparent balance between the two; and finally the pain overcame the suggestion, and the re-action was permanently inhibited. The stroking re-action gained all the strength of violent and intense association with the elements of this mental conflict, and was thus soon fixed and permanent.

Taking this as a typical case of "deliberative suggestion,"—and I could instance many others, less clear, from H.'s life-history,—my point is twofold: there is nothing here that requires will, meaning by "will" a new influence due to active consciousness (if we do call it will, we simply apply a different term to phenomena which in their simplicity we call by other names); and, second, suggestion is as original

a motor stimulus as pleasure and pain. Here they are in direct conflict. Can we say that H. balanced the pleasure of scratching and the pain of punishment, and decided the case on this egoistic basis? And, if suggestion be an original stimulus, why may it not be an altruistic suggestion, — my pain and your pleasure as well as your pain and my pleasure?

There are two (or more) suggestions, *sg* and *sg'* (Fig. 4), each either sensory or ideal. They arouse a motor process which is the union of two processes (*mp* and *mp'*). In the instance above, the scratch suggestion *mp* controls, gives the re-action *mt* and its consciousness *mc*.

4. *Imitative Suggestion*.—For a long period after the child has learned to use all his senses, and after his memory is well developed, he lacks entirely the instinct of imitation. I have been quite unable in H.'s case to confirm the results of Preyer, who attributes imitation to his child at the age of three to four months. I experimented again and again, and in a great variety of ways, but failed to get any thing like a decisive case of imitation till the eighth month; that is, till after the will was clearly beginning to show itself. During this period, however, H.'s consciousness was a rich field of suggestive re-actions of the other classes. There were, earlier, a few instances of apparent imitations of movements of opening and closing the hands, but they turned out to be

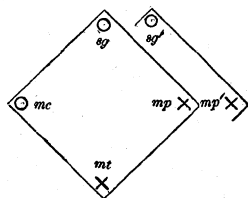


FIG. 4.—DELIBERATIVE SUGGESTION.

accidental. I think it likely that observers are often deceived as respects imitation, taking happy coincidences for true instances; yet it is possible that H. was peculiar in regard to this.

When the imitative impulse does come, it comes in earnest. For many months after its rise it may be called, perhaps, the controlling impulse, apart from the ordinary life processes. As a phenomenon, it is too familiar to need description. Its importance in the growth of the child's mind is largely in connection with the development of language and of muscular movement.

As a factor in motor development, — the aspect now before us, — the phenomena are plain enough, and may be divided into two general classes, called *simple imitation* and *persistent imitation*.¹ By simple imitation I mean to characterize re-actions in which the movement does not really imitate, but is the best the child can do. He does not try to improve by making a second attempt. This is evidently a case of simple sensori-motor suggestion on the physiological side, and is peculiar psychologically only because of the more or less remote approximation the re-action has to the stimulating

movement. If this were all that imitations are worth, we might omit their further treatment.

But in *persistent imitation* we have a very different phenomenon, — a phenomenon which marks the transition, as I conceive, from suggestion to will, — from the re-active to the voluntary consciousness. Such imitation is necessary, I think, as a stimulus to the tentative voluntary use of the muscles. Professor Bain's theory that all voluntary movements are led up to by accidental spontaneous re-actions which result in pleasure or pain, will not hold water for an instant in the presence of the phenomena of imitation. Suppose H. endeavoring in the crudest fashion to put a rubber on the end of a pencil, after seeing me do it, — one of her earliest imitations. What a chaos of ineffective movements! But after repeated efforts she gets nearer and nearer it, till at last, with daily object-lessons from me, she accomplishes it. Here, simply by imitation, one of the most valuable combinations for future manual manipulation is acquired. Suppose there had been no impulse to do what she saw me do, no motor force in the simple idea of the rubber on the pencil: what happy combination of Mr. Bain's spontaneous movements would have produced this result, and how long would it have taken the child if she had waited for experiences actually pleasurable and painful to build up this motor combination?

In cases of imitation there is no chance for association as such. The movements imitated are new as combinations. It is probable, it is true, that various ideas of former movements are brought up, and that the child has the consciousness of general motor capacity, resting, in the first place, upon spontaneous impulsive re-actions; but on this insufficient associational basis he strikes out into the deepest water of untried experience. For this reason, as was said above, I believe that persistent imitation comes only after there is will; meaning by "will," at this stage of it, that this consciousness of motor capacity is not held down to actual memories of past re-actions, but becomes generalized mentally and motorly beyond its legitimate physiological data. Physiologically, we would expect that the brain energy released by a new stimulus (pencil-rubber combination) would pass off by the motor channels already fixed by spontaneous, reflex, and associated re-actions; i.e., that the child would be content with a motor re-action of any kind. But not so. It is not content until it produces a new re-action of a particular kind, and we must suppose that in consequence of each effort of the child the physical basis is in some way modified, in so far violating strict nervous association, until the one re-action imitated is performed.

The peculiarity of persistent imitative suggestion, accordingly, is that it involves will, and yet is not a voluntary motor re-action. The muscular movements in putting on the rubber is not the child's pictured end: the idea of the rubber on the pencil is her end. Nor is she conscious of the motor re-action as a means to that end. It is probable that the muscular movements figure in her consciousness, if at all, only in the vaguest and most undefined associative way.¹ They represent simply the nervous channel into which the eye-stimulus empties itself.

Further, the re-action at which imitative suggestion aims is one which will reproduce the stimulating impression, and

¹ Preyer's distinction between "spontaneous" and "deliberate" imitation, *Senses and Will*, p. 293. He is wrong, I think, in making both classes voluntary. The contrary is proved for spontaneous imitation by the fact that many elements of facial expression are never acquired by blind children. We could hardly say that facial expression was a voluntary acquisition, however gradually it may have been acquired.

¹ See PREYER, *Senses and Will*, p. 254.

so perpetuate itself. When a child strikes the combination required, he is never tired of working it. H. found endless delight in putting the rubber on and off again, each act being a new stimulus to the eye. This is specially noticeable in children's early efforts at speech. They re-act all wrong when they first attack a new word, but gradually get it moderately well, and then sound it over and over in endless monotony. The essential thing, then, in imitation, over and above simple ideo-motor suggestion, is that *the stimulus starts a nervous process which tends to reproduce both the stimulus and the process again*. From the physiological side, we have a circular activity,—sensor, motor; sensor, motor; and from the psychological side we have a similar circle,—reality, image, movement; reality, image, movement.

The square to the left (Fig. 5) is the first act of imitation; the movement (*mt*) now stimulates (dotted line) the eye again (*sg'*), giving the second square, which by its movement (*mt'*) furnishes yet another stimulus (dotted line with arrow); and so on. The element of will makes slight changes in this diagram, but they may be omitted in this connection.

With the foregoing descriptions in mind, we may gather up the facts of suggestion. Particular statements of the

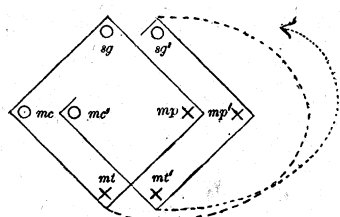


FIG. 5.—PERSISTENT IMITATION.

principle from the side of the nervous system are as follows:—

Physiological suggestion is the tendency of a reflex or secondary-automatic process to get itself associated with and influenced by other sensory or ideal processes. Perhaps the plainest case of it on a large scale is seen in the decay of instincts when no longer suited to the animal's needs and environment.

Sensori-motor suggestion is the tendency of all nervous re-actions to become secondary-automatic and reflex, seen in simple imitation and the passage of the voluntary into the involuntary.

Deliberative suggestion is the tendency of different competing sensor processes to merge in a single motor re-action, illustrating the principles of nervous summation and arrest.

Persistent imitative suggestion is the tendency of a sensor process to maintain itself by such an adaptation of its re-actions that they become in turn new stimulations.

And from the side of consciousness, suggestion in general is the tendency of a sensory or ideal state to be followed by a motor state.

Whether any simpler formulation of these partial statements may be reached, is a question which may be delayed until we have looked more closely at the voluntary life.

J. MARK BALDWIN.

NOTES AND NEWS.

BESIDES the hides of the alligator, of which fifty thousand or sixty thousand are annually utilized in the United States, there are other commercial products obtained. The teeth, which are round, white, and conical, and as long as two joints of an average finger, are mounted with gold or silver, and used for jewelry, trinkets, and for teething babies to play with. They are also carved into a variety of forms, such as whistles, buttons, and cane-handles. This industry is carried on principally in Florida. Among the Chinese druggists, as stated in the *Journal of the Society of Arts*, London, there is a great demand for alligators' teeth, which are said to be powdered, and administered as a remedy. As much as a dollar apiece is paid by them for fine teeth. All the teeth of the alligator are of the class of conical tusks, with no cutting or grinding apparatus; and hence the animal is forced to feed chiefly on carrion, which is ready prepared for his digestion. Other commercial products of the alligator are the oil and musk pods. The tail of an alligator of twelve feet in length, on boiling, furnishes from fifty to seventy pints of excellent oil, which, in Brazil, is used for lighting and in medicine. The oil has been recommended for the cure of quite a variety of diseases. It has a high reputation among the swamper as a remedy for rheumatism, being given both inwardly and outwardly. The crocodiles and alligators possess four musk-glands, — two situated in the groin; and two in the throat, a little in advance of the fore-legs. Sir Samuel Baker says they are much prized by the Arab women, who wear them strung like beads upon a necklace.

— A series of explorations of great interest have, during the past two years, been carried out by two French travellers, MM. Catat and Maistre, in little-known regions of the island of Madagascar. The results accomplished by these travellers were described by M. Grandidier, the well-known authority on Madagascar, at a recent meeting of the Geographical Society of Paris, an account of which is given in the "Proceedings of the Royal Geographical Society" for February. In the summer of 1889 the "Radama I." route from the capital to Tamatave was explored, with the result that it was found to be not so short or so practicable as the ordinary route. The travellers discovered a marshy zone called Didy, similar to the great lacustrine plain of Antsihanaka, lying between the central mountains and the coast range. Two days were occupied in crossing this hitherto unknown marsh, which gives rise to the river Ivondrona, one of the principal streams of the eastern part of the island. The travellers then proceeded to the bay of Antongil, with the intention of crossing the island along the 16th parallel; but M. Maistre was attacked by fever, and returned to Antananarivo, not, however, by the usual route, but through the province of Antsihanaka, which he found to be placed too far eastwards on recent maps. M. Catat, meanwhile, crossed the island from the east, and reached the west coast at Majonga. He found that the great central mountain mass does not extend, as hitherto supposed, to the 16th parallel; and that the great plains of secondary formation, with their characteristic vegetation of twisted and stunted Bourbon palms and other special trees, occupy here more than two-thirds of the country. The elevated zones of the eastern slope of the coast range are covered with forests, which belong to the first belt of forests running through the whole length of the island; but M. Catat found no trace in this region of the second belt, parallel to the first, which clothes the slopes of the central mountains between Ikongo and Antsihanaka. M. Catat returned from Majonga to the capital, up the valley of the Ikopa. The two explorers subsequently visited together the south of the island, where they discovered the sources of the Omlahy, which discharges itself into the Bay of St. Augustine, also those of the rivers Manambovo and Mandrany, and of one of the head streams of the Mananara, and were thus able to determine the watershed of the principal streams of this southern region. They returned from Fort Dauphin along the south-east coast to the mouth of the Mananara, which they ascended as far as Ivohibé, and surveyed the hitherto unknown course of this important river. Their collections will, it is stated, prove to be of much interest to anthropologists and naturalists.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.
Great Britain and Europe..... 4.50 a year.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

AMERICAN ZOÖLOGISTS will certainly be glad to hear that the Zoölogical Station at Naples is once more open to them. Through the liberality of Major Alex. Henry Davis of New York a table has been secured until January, 1892, and now awaits its occupancy by some American investigator. Major Davis became interested in the matter while in Naples last January, and paid for a table during the current year in addition to promising his support and influence toward making the arrangement permanent. The United States has been represented at the Naples Station but twice since its foundation, although a score of American workers have enjoyed its privileges within that time. Williams College held a table for two years, and the University of Pennsylvania for one. Naturally the undertaking proved too expensive, and of too little value to any one institution to warrant the permanent maintenance of a table; and during the past six years only such Americans have been able to work there as have enjoyed the personal courtesy of the director, Professor Anton Dohrn, or as have been temporarily occupying tables of some European state. Last year two American workers were at the station, dependent upon the sufferance of German hospitality for their places, and had the very doubtful pleasure of seeing every civilized nation present in its representatives except their own. Now that the United States no longer occupies the anomalous position of being the richest and most prosperous nation of the world, and yet the one most indifferent to this grand international undertaking, American workers may hope to see the matter taken up by the national authorities or in some other definite way that will assure its permanency.

ALEXANDER WINCHELL, LL.D., of the University of Michigan, died at Ann Arbor, Feb. 19. Professor Winchell was born at North East, N.Y., on the 31st of December, 1824, and graduated at Wesleyan University in 1847. The following year he became a teacher of natural science at Amenia Seminary in New York State, but only remained one year, removing in 1849 to Alabama, where he continued his work as a teacher in connection with several institutions. In 1854 he became professor of physics and civil engineering in the University of Michigan, but a year later he naturally gravitated to the professorship of geology and natural science, retaining the position until 1872. In 1859 he was appointed by the State authorities director of the Geological Survey, and pushed the work energetically until the outbreak of the war arrested its further progress. He was again connected with the survey in 1869, when it was resumed, but resigned two years later. From 1866 to 1869 he also held the corresponding chair in connection with the Kentucky University. In 1873 he left the Uni-

versity of Michigan to accept the chancellorship of Syracuse University, but held the place only one year, retiring to accept the professorship of geology, zoölogy, and botany; and again from 1875 to 1878 he did double duty, filling the same department in Vanderbilt University in connection with his duties at Syracuse. About this time he contributed a series of articles to the *Northern Christian Advocate*, published in Auburn, N.Y., in which he defended a belief in the existence of a pre-Adamite race, and also intimated his concurrence in the theory of evolution. For these views, deemed unsound by the authorities of Vanderbilt University, he was called upon to resign his professorship, but refused, and his lectureship was abolished. Quite a prolonged and bitter controversy was the result, and he fell into much disfavor among many of his fellowship in the Methodist Episcopal Church. In 1879 Professor Winchell was called to the chair of geology and paleontology in the University of Michigan, which he retained until his death. Among his works are many official reports and a number of books on evolution, and extensive contributions to scientific periodicals. His bibliography includes about two hundred titles.

THE ZIMBABYE AND OTHER RUINS IN MASHONALAND.

THE following information regarding these famous ruins was received from Mr. E. A. Maund by the Royal Geographical Society, London, which he obtained from Mr. Phillips, in correction and amplification of the remarks made by him at the meeting of the society on the 24th of November, 1890.¹

Mr. Phillips was all over that part of the country in 1866, and was with Mr. Hartley the year after, and saw many old gold-diggings near the hill which then first got its name of Hartley Hill. In 1868 he and Mr. Westbeach crossed the Hanyani and went down the Mazoe. In October, 1871, he was hunting at the junction of the Ingwesi and Lundi Rivers, when a letter was brought to him from Herr Mauch. It was not signed, but the writer reminded him of an adventure they had had together with five lions on the Mahalapsi, so that he might identify him. Mauch said he was living with a man named Renders (not Kinders), and was in a bad plight, having been robbed of every thing except his papers and gun. He begged him not to bring a Matabele with him, as they were living among the Mashonas. Phillips went and found Mauch and Adam Renders, an American, living on the top of a kopje, a few miles south-west of the ruins of Zimbabwe. It was a pretty place. A waterfall coming down from the ridges above fell into a pan by the hut, in which it disappeared, to come out again in a gushing fountain several hundred feet below, a cave of refuge being close by, with water flowing through it, to which they and their Mashona hosts could fly, and barricade themselves in with a bowlder of rock, when Matabele raiding parties were afoot. Mauch told him of some ruins in the neighborhood, and next day the party went to see them.

It was really Renders who first discovered these ruins, three years before Mauch saw them, though Mauch and Baines first published them to the world, and they only described what the old Portuguese writers quoted by Mr. Maund talked of hundreds of years ago. Mauch, on their arrival at the Zimbabwe ruins, asked what they thought of them. He (Phillips) confessed he was not greatly impressed, as they were exactly like several others he had seen in other parts of the country. There were the same zigzag patterns, and the mortarless walls of small hewn stones.

Shortly before, when hunting in the mountains to the west of Zimbabwe, he had come upon a regular line of such ruins, one of which must have been a very large place. It had three distinct gateways in the outer wall, which were at least thirty feet thick at the base; and an immense ironwood tree, that would have taken hundreds of years to grow, had grown through a crevice in the wall and rent it asunder. On the side of a gateway were vast heaps of ashes, with occasional potsherds about, the only evidence of the old inhabitants.

¹ Proceedings of the Royal Geographical Society, January, 1891, p. 20.

He had found the same kind of ruins all over the country, very frequently on the summit of difficult kopjes. Those at Tati and Impakwe are good examples; but the most perfect, perhaps, of all lies north-west of Tati. The tower there is about sixty feet in length and breadth, and eighty feet high; the walls about fifteen feet thick; and it is entered by a passage winding spirally to the top, which is so arranged as to be commanded by archers from the interior all the way, and is so narrow that it admits of the passage of one person only at a time.

DEVELOPMENT OF MODERN MARINE ENGINEERING.¹

THE development of modern marine engineering in the United States may fairly be said to have begun with the construction of the engines of the steamship "George W. Clyde," by William Cramp & Sons, in 1871, which were the pioneer two crank compound engines in America. Prior to this our engineers and machinists had brought the simple engine to its zenith of possible development, but with the advent of the compound engine that era ceased to be of interest except in the historical sense.

The discovery of the principle of expansion, and the theory of the compound engine based upon it, long antedate their practical application. The earliest works on steam engineering contain evidences of knowledge of the principle, and foreshadow the application of expansion; but the compound engine as a practical fact is only about twenty-four years old in England, and about twenty years old in the United States. Its success as a fuel economizer at once dominated the construction of simple engines, and all other American ship-builders were compelled to follow Cramp's lead.

From the "George W. Clyde," in 1871, to Mr. Jay Gould's celebrated steam-yacht "Atalanta," in 1882, a period of eleven years, the development of the compound engine was steadily pushed to its climax of air-tight fire-room, forced draught, and the highest boiler-pressure consistent with economy in double expansion. This limit was reached in the "Atalanta;" and during the intervening period Messrs. Cramp & Sons had built about 70,000 registered tons of iron steam shipping, besides a number of yachts and other small crafts.

The era of double expansion terminated in 1885, with the construction of the steam-yacht "Peerless," which was equipped with the first triple expansion engines built in the United States.

This remarkable little ship was built by Cramp & Sons on their own account, at a cost approximating \$100,000, simply as a practical experiment in the direction of the advance from two to three expansions of working steam. The result of the experiment left no room for argument as to the efficacy of the new system; and, though a few merchant ships were afterwards built by them with ordinary compound engines, they were merely duplicates of earlier vessels, and none but triple expansion engines were ever afterward designed or recommended by that firm.

In the "Peerless," as an experimental ship, Messrs. Cramp & Sons went to what has since been recognized as the upper limit of economical boiler-pressure for the purposes of triple expansion, which was 155 pounds. The registered tonnage of the "Peerless" was 228 only, but her engines developed about 1,060 indicated horse-power, giving her a speed of $17\frac{1}{4}$ knots, which made her the fastest steam-yacht of her time and class.

From the "Peerless" in 1885 to the "Vesuvius" in 1889 was a period marked by tremendous progress. In the latter vessel a power of 4,440 horses was developed in 253 tons weight of machinery, and applied to the propulsion of about 905 tons of displacement, the result being a speed of 21.65 knots an hour.

During this period Messrs. Cramp & Sons also built the horizontal triple expansion engines of the "Newark," "Philadelphia," "Baltimore," and "Yorktown," United States men-of-war, together with about 56,000 horse-power of triple expansion machinery for merchant vessels, a compound oscillating engine for the Stonington Steamship Line steamer "Connecticut" (with cylinders 56 inches and 104 inches respectively, and 11 feet stroke),—the largest engine of that type ever built, and carrying 110 pounds of steam-pressure,—together with several heavy compound pumping-

engines for water-works, ranging in capacity from 10,000,000 to 20,000,000 gallons per day.

Advantage was taken of this school of development by the Navy Department, and Chief Engineer George W. Melville was stationed at the ship-yard of Cramp & Sons as inspector of machinery. While serving as such, Mr. Melville designed the engines of the cruiser "San Francisco," and laid broad and deep the foundation of that knowledge of marine engineering which, since his promotion to the chiefship of the Bureau of Steam Engineering, has found expression in a group of machinery designs aggregating over 150,000 horse-power, all of which are now in various stages of construction, and classed by all competent critics at home and abroad as representing advanced types of marine engineering in every sense.

The latest of Messrs. Cramp & Sons' engines brought to trial are those of the United States cruiser "Newark," which are of the horizontal, direct-acting, three-cylinder type. They weigh, including water in the boilers, 761 tons, and developed, on four hours' trial, 8,660 indicated horse-power, or 11.64 horse-power to the ton of weight, which exceeds any other performance of that type of machinery.

At the present time this concern has in the course of construction the machinery for two 10,000-ton battle-ships, one armored cruiser of 3,100 tons, and one protected cruiser of 7,300 tons, embracing, in all, eleven engines of approximately 60,000 indicated horse-power, of which three are to be placed in the latter vessel to drive triple screws, and designed to produce a speed of 21 knots.

It is quite generally conceded that, in the production of these colossal machines, the limit of size and weight of boilers of the cylindrical or tubular type has been reached; those for the armored cruiser "New York" having a diameter of 15.9 feet, requiring a shell plate thickness of 1.32 inches, and weighing 70 tons each when ready for installation on board ship.

The machinery plans for the 8,200-ton armored cruiser, and the 7,300-ton protected cruiser, present several interesting novelties. The first named is to be powered with four engines, two working on each shaft, and provided with means of disconnection so as to cruise under half power under ordinary circumstances. These four engines are installed in separate water-tight compartments. The power is 4,500 each, or 18,000 collectively, and is expected to produce a speed of twenty knots.

In the 7,300-ton protected cruiser there are to be three engines, on three shafts. Two of the engines, driving the port and starboard shafts, are placed in the usual manner on twin screw vessels. The third, driving the central shaft, is placed abaft the other two, each having its own compartment.

These are to be among the most powerful machines ever built, having 7,000 indicated horse-power each, or 21,000 collectively, and are to produce a speed of twenty-one knots.

SUBMARINE GUNS.

C. S. BUSHNELL of New Haven, vice-president of the Ericsson Coast Defence Company, which has just had the old "Destroyer" taken out of the Brooklyn Navy Yard and hauled up on Simpson's dry dock at South Brooklyn for repairs, says, in the *New York Times*, in regard to the fitting-up of the vessel for the trial of a newly invented gun,—

"On the 'Destroyer' the late Capt. Ericsson and C. H. Delamater spent \$150,000. The vessel is 120 feet long, and is substantially constructed, though now in great need of repairs. Our company has a capital of \$250,000. We are fitting up the vessel for the purpose of testing a gun that will fire under water. Now, with the heavy nettings which the big war-vessels have for the protection of themselves against torpedoes, the ordinary projectiles are almost useless.

"But with the gun that is to be tested on the 'Destroyer' we can make a projectile penetrate any of the nettings that are now in use. We are to use a sixteen-inch gun. That which we will experiment with is being constructed at Bethlehem, Penn., and is about half done. It is to be 35 feet in length. The projectile is to be 25 feet long, and to throw it a charge of twenty-five

¹ From The Crank.

pounds of powder will be used. The shell will contain from 300 to 400 pounds of nitro-glycerine, enough to blow up any vessel afloat if struck right. The muzzle of the gun will protrude for ten feet under water, and the projectile will be carried from 750 to 1,000 feet. The projectile will extend eight feet beyond the muzzle of the gun before firing. We intend to try the gun for the first time at Newport next July, having obtained from Congress an appropriation for making the tests.

"With a few such vessels as the 'Destroyer' will be when equipped with our gun, the armed fleets of the world could be swept out of existence. I believe that this invention will revolutionize naval gunnery throughout the world. One of our shells can be sent right through the netting and into the side of a vessel, where a torpedo could not penetrate. Commodore Folger of the Ordnance Department has written a letter to me, saying that he has prepared a heavy steel netting for a target, upon which our gun can be tested. Later we shall buy an old hulk and blow it up with one of our percussion shells, to show the efficacy of the new gun.

"I think that if the test proves satisfactory the government will arm some of the naval vessels with it. For the price that one of our big new ships would cost we could build and arm five of the smaller ships, which would be able to sink the best navy afloat. If the nations should arm their navies with these guns, it would so enhance their destructive power that the powers would not dare to go to war with each other. Since ships have been armed with the Hotchkiss rapid-firing guns, there has not been a naval battle. In a sea fight these guns would cause terrible havoc. Vessels of the 'Destroyer' type are to be heavily armored, so that they can approach any vessel without being injured. These vessels will be only a foot out of the water, and that part will be armored, so very little will be exposed to an enemy's guns. One of these vessels, made to steam at great speed, can be made very effective."

Mr. Bushnell was associated with Ericsson in the construction of the "Monitor."

HEALTH MATTERS.

African Arrow Poison.

THE poisons used by the natives of Africa to render fatal the wounds made with their arrows, as described by Mr. Stanley in his recent work on Africa, are, when fresh, of most extraordinary power. Faintness, palpitation of the heart, nausea, pallor, and beads of perspiration break out over the body with extraordinary promptness, and death ensues. One man is said to have died within one minute from a mere pin-hole puncture in the right arm and right breast; another man died within an hour and a quarter after being shot; a woman died during the time that she was carried a distance of a hundred paces; others died in varying spaces of time up to a hundred hours. The activity of the poison seemed to depend on its freshness. The treatment adopted, as we learn from the *Medical and Surgical Reporter*, was to administer an emetic, to suck the wound, syringe it, and inject a strong solution of carbonate of ammonia. This carbonate-of-ammonia injection seems to have proved a wonderful antidote, if it could be administered promptly enough. One of the poisons with which the weapons are smeared is a dark substance like pitch. According to the native women, it is prepared from a local species of arum. Its smell when fresh recalls the old blister plaster. It is strong enough to kill elephants. This poison is not permitted to be prepared in the village. It is manufactured and smeared on the arrows in the bush. These results of the African arrow poison are quite remarkable; but it would be interesting to know if they owe any thing to fear and its effects, or if similar results can be obtained by inoculating the lower animals.

Inoculation of Dog Serum as a Remedy for Tuberculosis.

In a series of communications made in the course of the last two years to the Société de Biologie, MM. Héricourt and Richet have given the results obtained by the injection of the blood of an animal refractory to tuberculosis, such as the dog, into the economy of one susceptible to the onslaughts of the bacillus. They have demonstrated experimentally, according to the *Lancet*, that such a proceeding exerts a retarding influence on the evolution

of tuberculosis artificially communicated, without, however, stopping it altogether. With a view of intensifying these partially protective properties of canine blood, they inoculated the dog with a large dose of very active tuberculous matter, and one month later (the animal having lost flesh, and exhibiting manifest signs of ill health) injected into the peritoneal cavity of three rabbits seventy cubic centimetres of the dog's blood. A week later these rabbits were, with three other test-rabbits, inoculated with strong tuberculous virus, with the result that in twenty-five days two of the latter had succumbed, the rest surviving. Their ultimate fate is not recorded. Encouraged by these results, MM. Héricourt and Richet have extended the application of their method to tuberculous human beings, employing the serum only, and selecting the interscapular region as the seat of inoculation. M. Richet reports (*Société de Biologie*, Jan. 24) that four phthisical men have, since the early part of December, 1890, been subjected to this novel treatment. The results obtained seem to warrant the assumption that the introduction of the serum of dog's blood into the human economy counteracts, to some extent at least, the noxious influence of Koch's bacillus.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Can One see the Blood-Corpuscles in his own Eyes?

To some this may seem an idle question,—an absurdity; but when we remember that the sensitive layer of the retina is on the back side, and that there are blood-vessels in front of it, it may not seem so improbable. Nevertheless, the ease with which it may really be done is quite surprising.

If the eyes are turned toward a dimly lighted blank space, and adjusted to see distant objects, or as when we "gaze on vacancy," there will appear fitting across the illuminated area small bright spots. They will seem to flash into vision, pass over a few degrees, usually in a curved path, then suddenly disappear. The circumstances found favorable for observing this phenomenon are to look toward the sky or a snowy surface on a cloudy day, or on a brighter day with the eyes nearly closed. Seldom more than a dozen of these luminous points may be seen at once, and usually not more than two or three distinctly.

They may be easily distinguished from the tear-drops trickling over the front of the eye, which are often visible at nearly the same time, by their being of uniform size, and moving rapidly in different directions; while the tears are of variable size, like rain-drops on a window-pane, and move slowly downward, or by the motion of the eyelids upward.

They are not to be confounded with *muscæ volitantes*, which are of variable shape, size, and color, and, besides, slow of motion, and not so quickly disappearing.

That these minute bodies are really red corpuscles floating through the retinal capillaries, is indicated by the following facts:—

1. They move in definite paths. Having noted one, another will be seen to pass exactly the same path in from half a second to two seconds.
2. They always move in the same direction in the same path, never back and forth.
3. They are of uniform size, and appear to be of a yellowish color.
4. By comparing them with objects of known size at known distances, they have been approximately estimated to correspond in size to red corpuscles. Accurate measurements seem impracticable from the nature of the case.

The reason that they are visible while the capillaries in which they float are not, is easily explained by the familiar principle that we become insensible to that which is constantly present, and are specially impressed by that which is transient or novel. The familiar experiment of Purkinje shows us that the capillaries may become visible when light comes from a novel direction, so

as to throw their shadows on a new portion of the rod-and-cone layer. From the nature of the case, the corpuscles cannot be rendered invisible, like the capillaries.

The phenomena described above were first observed by the writer a dozen years ago; and, though it is probable that others have observed the same, consultation with persons and books that would be likely to furnish the information of such knowledge have shown that these facts are either unknown, or at least not generally known. That the facts here published may be observed by any one seems proved by the fact that they have been corroborated by almost every one who has made the attempt under the writer's direction.

J. E. TODD.

Tabor College, Tabor, Io., Feb. 16.

Classification of American Languages.

IN your issue of Feb. 6 appears an article by Major J. W. Powell, chief of the Bureau of Ethnology of the Smithsonian Institution, on the study of what he calls "Indian" languages, with a list of families in the United States.

This article contains statements so much at variance with the leading authorities in linguistic science, that they should not be allowed to pass in silence.

In the first place, the term "Indian languages," applied to those spoken by the native tribes of this continent, is a misnomer based on an ancient blunder, and has been repudiated by all modern writers of weight. The so-called "Indians" are the "American race," and their languages are "American languages," by the common consent of ethnographers. Is the Bureau of Ethnology a sanctuary for the preservation of exploded errors, that it throws its influence into the scale to perpetuate this discarded blunder?

Much of the article alluded to is devoted to explaining and defending the nomenclature adopted by the bureau. In several points it requires still further defence. The arbitrary assumption of the date 1336, anterior to which the "law of priority" is decreed not to hold good, is not justified by the reasons given.

The dictum that "no family name shall be recognized if composed of more than one word," is not merely arbitrary, but has nothing in its favor and much against it. Frequently a class-name compounded of two words is particularly useful, as conveying a much wider idea than a single word. This is fully recognized by the best linguists of the day. Thus, Friedrich Müller employs the terms "Indo-Germanic," "Ural-Altaic," etc. The reasons assigned for rejecting such compounds are quite inadequate, and contrary to the practice of the highest authorities.

The adoption of the termination *an* or *ian* to denote families or stocks of languages is not original with our Bureau of Ethnology, though the article might lead the reader to suppose it a new device. Some writers adopted it long before the bureau was organized, but the plan did not meet with general approval. The cacophony of such words as "Eskimaun," "Muskhogan," etc., in Major Powell's list is apparent to every one who has not had the advantage of that training by the bureau to which he refers with pride as destroying all sense of euphony.

But the portion of the article in question which will most completely "knock the wind" out of those old-fogy linguists in Europe, and those in our own country who have been reared on Aryan and Semitic tongues, is Major Powell's declaration that "grammatical similarities are not supposed to furnish evidence of cognation;" that in his classification grammatical structure has been neglected, and lexical elements only considered.

Now, if it were said that in most instances we are obliged to depend on lexical elements because the grammatical structure has not been ascertained, the position would be sound and in accord with the recognized principles of the science of language; but to place the words of a tongue above its grammar in instituting comparisons is a feat of such daring or of such ignorance, that it requires a man long accustomed to frontier life to venture it. If there is any one principle in modern linguistics which we may look upon as thoroughly established, it is that the grammatical framework of a language is incomparably more stable than its lexicon. If there has ever been an instance where a language of agglutination has changed into one of inflection, it is not recorded

"in the books." It is precisely the grammar which is the permanent part of a language, and not its vocabulary. Modern Turkish has borrowed three-fourths of its words from Arabic, Greek, Persian, etc.; but its grammar remains almost precisely that of the pure stock, the Yakut of the delta of the Lena. This principle is as true of American tongues as of others, and the evidence of it has been abundantly set forth by Friedrich Müller and Lucien Adam.

D. G. BRINTON, M.D.

Philadelphia, Penn., Feb. 20.

The Food of Moles.

It is stated in the "Encyclopædia Britannica" that moles are entirely carnivorous, are exceedingly rapacious, and will die if left longer than eight or ten hours without food. I recently kept a living mole for a time to study its habits. I shut it in a ventilated wooden box, giving it a tin lid full of water, and some grains of corn. It drank the water, refused the corn, and, while kept strictly in the dark, was quiet. After twelve hours' captivity I offered it boiled rice, which it refused. After sixteen hours' fasting, it ate bread and milk, though not freely. When I had had it twenty hours, I gave it cracked oats, soaked well in milk, but uncooked. This it ate ravenously. I then released it in the room, and it travelled about, seeking a place to burrow, and made itself troublesome tearing at the carpet and upholstery. I threw down a large thick woollen mitten, which it speedily found and entered, thrusting its head into the thumb. If undisturbed, it would hide in this way for hours, the light and warmth of the room seeming greatly to annoy it. It lived in the mitten for three days, coming out to eat oats soaked in milk, but refusing cooked oats. It was given one small meal of raw meat. At the end of four days it was killed, being apparently in a healthy condition, and not having lost any flesh.

JULIA McNAIR WRIGHT.

Fulton, Mo., Feb. 20.

Cold and Warm Waves.

Two rival theories have been propounded recently regarding the origin of the waves or masses of cold air which appear to traverse the country toward the east. One of these finds the source of cold in the upper regions of the atmosphere, and considers that the cold air above mixes with that below, and thus gradually approaches the earth's surface. Those supporting the other theory, however, deny that any considerable cold can be brought down in this way, because the compression to which the air would be subjected would heat it, but they claim that the cold is due to the radiation of heat through the very clear sky which is a well-nigh invariable accompaniment. Without expecting to establish the exact truth in this matter, it has yet seemed a subject of much importance; and it may be well, at this stage in the discussion, to set forth a few facts that may be of use in the final solution of the problem.

Those who have been making forecasts of the weather have recognized for more than a dozen years three great classes of temperature falls: 1. Those which come with the advance of areas of high pressure; 2. Those which follow immediately in the rear of great storms independently of any high area; 3. Those which occur under a combination of these two causes. It should be noted that the first two classes do not invariably occur even when the conditions seem favorable, and great care is needed in examining other conditions, which, though apparently remote, may yet become exceedingly important factors in the development of the cold wave. The occurrence of the cold is independent of the wind, though the extent of the wave is markedly dependent on the rapidity of its advance, and a rapid motion has a tendency to increase the wind. Some have thought that the wind brings the cold; but this cannot be the case, for often there is no wind, or at least it rarely attains fifteen miles per hour, while the cold wave advances at double that velocity. One of the essential conditions needed for a cold wave is an elimination of the moisture in the air, and this removal of moisture is oftentimes very remarkable. In one case three-fourths of this moisture was removed in 110

minutes. This action may precede the fall in temperature by several hours, or the two may be very near each other, but it is very rarely that the diminution of moisture does not take place with sufficient rapidity to prevent the formation of fog from the lowering of temperature to the dew-point. The cause of this marked drying it is not easy to find; but it is not due to a drying wind along the earth's surface, though it may be due, in part, to a settling of dry air from above.

What causes the cold wave? The simplest explanation would be that the air radiates its heat to the abnormally clear sky; but such radiation from the air, it is generally recognized, would produce a very slight cooling. That this cooling is slight can often be determined when no cold wave is in progress. It is a significant fact that the cold wave strikes the high mountain summits before it does the base; for example, it has been shown that the temperature change at Mount Washington (6,279 feet) occurs from five to ten hours earlier than at the base. The same effect has been noted at Pike's Peak (14,134 feet), and there is no reason to doubt that it may be due to changes in the upper atmosphere many miles above our highest mountains. Does the cold air sink by gravity? The most serious objection to this view is that such action would seem to call for a displacement of the warm air beneath, or an admixture of the cold and warm air, at a much more rapid rate than can be accepted. The objection that such action would warm up the air from compression does not seem to be well taken. Certainly the appearance of the temperature fluctuation, which is precisely the same below as above, at Mount Washington, for example, shows no marked heating at the base. If we increase the density of air by pressure from outside, it would undoubtedly be warmed, but it is plain that air could not descend by gravity into other air (whether by displacement or admixture) unless it were denser than that below, and in such case the natural expansion would tend to slightly cool the air. Some have advanced such an idea in accounting for increased cold in the outskirts of an expanding cold wave, but it is very evident that such an effect would be well-nigh inappreciable. There is one fact that seems to show a tendency to a settlement of the upper air, in that the removal of the moisture occurs before the fall in temperature. This would seem to corroborate the view that the cool, dry air from above is slightly heated at first by contact with the lower air, and possibly by compression, and hence the drying process may anticipate the great cooling, though, according to my belief, such action is not at all needed to dry the air.

Both of these causes are concerned in some degree in our cold waves, but they do not seem to account for all the facts. Whatever the ultimate cause may prove to be, it is unquestionably related in a marked degree to the removal of moisture from the air; and until we can satisfactorily explain that, we cannot hope to explain the other. The intensity and extent of the cold wave are dependent upon the rapidity of the advance of this drying condition; and it is safe to say that this advance, whether in the front of a high-pressure area or in the rear of an area of low pressure, is entirely independent of the motion of a mass of air. The best proof of this is to be found in the fact that the high area, storm, and drying condition all advance at thirty, forty, or more miles per hour, while the air moves at less than half that velocity.

This brings us to the most important deduction to be made from this discussion. If there is no horizontal transfer of air in our cold waves, we may conclude that there is none in our warm waves. I am well aware that this proposition, already fully set forth in the *Scientific American* for Nov. 15 of last year, will call forth most serious opposition, as it strikes at the very heart of present theories of storm-generation. If the sun heats a limited portion of the earth's surface, and thus starts up an ascending column of warm, moist air, then our storms may be due to the forward motion of this column of ascending air which rotates at the same time that it advances; but, if there is no motion of air-particles in our storms, this theory falls to the ground. There have been set forth from time to time most serious objections to the ordinary theories, but it seems to me none have had the weight of this one here presented. This rise in temperature occurs in the upper air before it does at the earth, and is due, in

part, to a condition of the atmosphere which seems to intercept the heat of the sun. This condition is exactly contrary to that in a cold wave, and is brought about by a marked aggregation of moisture in our storms. This aggregation seems to take place far above our highest mountains.

We may conclude as follows:—

1. High-pressure areas and storms (or low-pressure areas) are conditions brought about by some effect other than the abstraction or addition of heat. Possibly they are produced by some form of electric energy, and are transported or transferred through the air without the motion of air-particles.

2. A portion of the cold in our cold waves is due to radiation, and another portion to the cold of the upper atmosphere, while possibly a larger portion cannot yet be accounted for.

3. A portion of the heat in our storms is due to a peculiar condition of the atmosphere which intercepts the heat of the sun, and this heat gradually works down from the upper atmosphere to the earth.

H. A. HAZEN.

Washington, D.C., Feb. 23.

The Instruction of the Deaf.

I DO not desire to take part in the discussion now going on in *Science* concerning the comparative excellence of the various methods of instructing the deaf. The truth with respect to these methods has recently been happily expressed by Miss Yale, the able principal of one of our best oral schools ("Twenty-third Annual Report of the Clarke Institution for Deaf-Mutes," 1890, p. 15): "Each system claims for itself distinctive merits and special adaptation. The justice of these claims is now generally conceded by the great body of those engaged in teaching the deaf."

I wish merely to correct an erroneous statement in Dr. Alexander Graham Bell's open letter to the Hon. William B. Allison, published in the last number of *Science*, with respect to the Columbia Institution for the Deaf, with which I have been connected for twenty-five years. Dr. Bell says, "3. In the Columbia Institution a foreign language (the sign-language) is used as the medium of instruction, whereas the rival methods employ the English language alone for this purpose."

In the Columbia Institution the sign-language is not used as the medium of instruction. In some classes it is used as a medium of instruction, being employed to communicate with deaf children at the beginning of their course, when they have no other means of communication whatever, and to promote their mental development, with respect to which Dr. Bell himself has said ("Proceedings of the Fifth Conference of Principals of Schools for the Deaf," 1884, p. 195), "In regard to mental development, undoubtedly nothing could reach the mind of a child like the language of signs;" it is also used, but very sparingly, in the earlier part of the course of instruction in connection with the English language, to explain and illustrate the meaning of words, where otherwise the explanation could not be given at all; and it is used throughout the whole course for public lectures and devotional exercises, no means of using the English language having yet been discovered which will satisfactorily take its place for this purpose.

Under all other circumstances — and these comprise the great part of the teaching given in the institution — the English language is the medium of instruction. There are classes in both the Kendall School and the National College — the two departments of the Columbia Institution — in which the English language is the only medium of instruction. I do not think that any of the schools following "rival methods" use the English language as a medium of instruction more than the Columbia Institution does.

EDWARD ALLEN FAY.

National Deaf-Mute College, Kendall Green,
Washington, D.C., Feb. 23.

P. BLAKISTON, SON, & Co., Philadelphia, will publish in March "A New Systematic Work on Surgery," by C. W. Mansell Moullin, surgeon to the London Hospital. They have also nearly ready "Plain Talks on Electricity and Batteries," for medical men, by Dr. Horatio R. Bigelow.

BOOK-REVIEWS.

Petrarch: A Sketch of his Life and Works. By MAY ALDEN WARD. Boston, Roberts Bros. 12°. \$1.25.

A WELL-WRITTEN biography of Petrarch in English is a good book to have; and Miss Ward, we think, has here supplied it. Her work is of moderate dimensions, yet it gives all the information about Petrarch that English readers are likely to need, and it is written in a plain yet easy and flowing style. It recounts the main events of the hero's life, his travels, his many friendships, his multifarious occupations, and his popularity, while at the same time keeping always in view the intellectual work for which posterity honors him. His personal character is made known to us by his letters and other works, and especially by his "Letter to Posterity," which is really an autobiography; and as thus revealed to our view he appears as an extraordinarily active, agreeable, and popular, but somewhat vain man, imbued with an intense passion for antiquity and for the political unification of Italy. Miss Ward, while evincing much admiration for Petrarch's sonnets, thinks, nevertheless, that his real life-work — "one of far more importance and far wider influence than any of his writings, whether Latin or Italian — was the opening of the gates of antiquity to the modern world." This seems to us perfectly just. Sonnets, we apprehend, have little interest for intellectual men at the present day, and will have still less in the years to come; but the men who led the way in reviewing the Greco-Roman civilization can never cease to be important in the history of human progress. That Petrarch was one of the foremost of these as well as one of the earliest, is what gives him his chief claim on our gratitude; and all who are interested in the story of that great awakening will find much pleasant reading and food for reflection in Miss Ward's little book.

AMONG THE PUBLISHERS.

THE observations made at the Blue Hill Meteorological Observatory, and the investigations of the New England Meteorological Society, are now published in the "Annals of the Harvard College Astronomical Observatory." The Blue Hill observations for 1889 include the continuation of the tabular records of previous years, with monthly and annual summaries of hourly values, with an introduction by Mr. Rotch. The record is discussed and published with exceptional fullness. The cloud observations carried on by Mr. Clayton are published in detail, and present a mass of fact from whose reduction we shall expect to see very interesting and novel results. Considering that cloud-movement is much more steady than the movement of surface wind, it is singular that instrumental means, such as are here employed for determining the direction and relative velocity of cloud-drift, have not been more generally introduced. They might at least be introduced at a number of signal-service stations in different parts of the country, in order to test the possibility of their use in storm prediction; for the methods of weather forecasting now in use cannot be regarded as satisfactory. A feature of the Blue Hill station is the relative small and irregular diurnal variation of the various weather elements: even the mean hourly temperature ranged only from 43° to 52.5°. The wind velocity, cloudiness, and rainfall are almost independent of the time of day. All these factors are, however, well known to be dependent closely on the position of passing cyclonic storms; and if referred to these controlling disturbances, instead of to the relatively unimportant changes from day to night, the natural variations of wind, cloud, and rain would undoubtedly stand forth in their true distinctness.

— The "Ninth Annual Report of the Director of the United States Geological Survey" is of somewhat less size than its two-volume predecessor, but is fully up to the average of the earlier seven volumes. Besides the administrative reports of the first two hundred pages, it contains an account of the Charleston earthquake of 1886, by Capt. C. E. Dutton; the geology of Cape Ann, by Professor N. S. Shaler; an explanation of the formation of travertine and silicious sinter in the hot-springs of the Yellowstone National Park, by W. H. Weed; and an essay on the geology and physiography of parts of Colorado, Utah, and

Wyoming, by Dr. C. A. White. Capt. Dutton's report is full of interest. The accounts of the earthquake and its effects, as presented in his memoir, will at once become the standard classic for this country, and the illustrations of damaged buildings will furnish material for all the new geographies and geologies for many years to come. The depth of the earthquake focus is placed at twelve miles, with a probable error of two miles. The velocity of the wave is determined to be about three miles a second, decidedly greater than has been found in other shocks; but, as the determination is based on good observations, the author is disposed to give it great weight, and to discard earlier results. Mr. Weed's essay on the travertine and silicious deposits of the hot-springs of the Yellowstone Park brings to light a process heretofore little suspected. The terraced formations of the springs are found to have been formed in great part by the agency of a low form of alga vegetation. He concludes that the plant life of the Mammoth Hot Springs causes the deposition of travertine, and is a very important agent in the formation of such deposits; that the vegetation of the hot alkaline waters of the geyser basins eliminates silica from the water by its vital growth, and produces deposits of silicious sinter; and that the thickness and extent of such deposits prove the importance of such vegetation as a geological agent.

— John Wiley, one of the oldest publishers in the United States, and well known among scientific men as the founder and head of the publishing-house of John Wiley & Sons, which has brought out so many engineering and scientific books in this country, died at his home in East Orange, Feb. 21. Mr. Wiley was born in Flatbush, L.I., Oct. 4, 1808, but his parents removed shortly after to New York. At seventeen he entered his father's store, the firm then being Wiley, Lane, & Co. Later, upon the death of his father, he succeeded to the business, G. P. Putnam being his partner at the time. Charles Wiley, his son, was admitted to the firm about forty years ago; and later William H. Wiley, well known among engineers, was also admitted, the firm name being changed to John Wiley & Sons. For nearly fifty years the office was in the old Mercantile Library building, recently demolished. Mr. Wiley was married in 1833 to Elizabeth S. Osgood. They had five children, — three sons and two daughters. Mr. Wiley was one of the original founders of the Church of the Puritans, this city, of which the Rev. Dr. Cheever was the pastor for so many years. He was an active member of the American Home Missionary Society, and for many years its president. He was also an active member of the Congregational Union of New York. He removed to East Orange in 1851.

— G. P. Putnam's Sons have in preparation "The Life and Writings of George Mason of Virginia," in the Early Statesmen Series; "Chapters on Banking," by Professor Dunbar of Harvard, and "The Industrial and Commercial Supremacy of England," by the late Thorold Rogers, in the Economic Monographs; and "Drinking-Water and Ice-Supplies," in Dr. Prudden's Health Manuals.

— The long-delayed Monograph I. of the Geological Survey on Lake Bonneville, an extinct lake of the Utah basin, by G. K. Gilbert, is at last published. The general character of the history of this ancient lake was given by the same author a number of years ago in the "Second Annual Report" of the survey; and in a later report there was an essay by him on the topographic features of lake shores, now reprinted, with little change, as constituting an element in the discussion of the Utah basin. As now presented, the entire essay is a model of elaborate and deliberate discussion. Taking the present monograph with the one on Lahontan by Russell, who was associated with Gilbert in the study of the Great Basin, it may be safely said that no other area of interior drainage in the world has received so complete an examination, nor has yielded results of such wide importance. The sensitiveness of interior lakes to variations in the relation of rainfall to evaporation renders them of the highest value as indicators of climatic changes in the past. With this point in mind, the interpretation of their deposits discloses the existence of two moist periods, with an interval of dryness; and these are correlated with the two glacial and the single interglacial epoch, not only by

inference, but by the direct association of morainic deposits with the lake beds. The volcanic manifestations during and after the existence of the lakes, and the faults occurring in the shore deposits, add interesting complications to this remarkable region.

— Professor J. C. Smock, lately appointed chief of the New Jersey Geological Survey, where he some time ago served as assistant under the late director, Professor Cook, has prepared a report on the building-stones of New York, issued in the second volume of the bulletins of the University of the State of New York, where Professor Smock has been engaged as economic geologist of the State Museum for several years past. Reference is made to previous works of the kind, such as Julien's "Report on the Building-Stones of New York" in the Tenth Census, Merrill's "Building and Ornamental Stones in the United States National Museum," the author's quarry list in a previous bulletin, and others. The bulletin contains an introductory statement of the classification adopted: namely, crystalline rocks, embracing granites and gneisses, trap rocks, and limestones and marbles; second, fragmental rocks, including sandstones, conglomerates, and slates. The limestones and sandstones are further arranged according to the geological formations from which they are obtained. A hundred pages are then given to a recital of the localities of quarries throughout the State. The uses, tests, and durability of the different kinds of stones occupy as many more pages. Under the first of these headings, we find a list of stones used in the more

important buildings all over the State. A map is given at the end of the volume, with the names of quarry districts underlined in red.

— The first geological survey of Ohio was undertaken in 1836, and continued for two years. The work then lapsed until 1869, when it was begun again with greater vigor, Professor Newberry being in charge; and under his direction and that of his successor, Professor Edward Orton, numerous reports were issued down to 1888. Owing to the reckless and irregular method of distributing these volumes, complete sets are not often found, although editions of 20,000 of certain volumes were printed. In 1889 a third organization of the survey was made, and it is now regarded as a continuous official department of the State. Professor Orton is still in charge. The first annual report under these new conditions is just issued. It gives a brief review of the previous surveys, from which the above notes are taken; a general sketch of the results of the previous surveys, with corrections of certain earlier statements in the light of recent explorations; and a large amount of material concerning the natural gas and oil, which have attracted so much attention during the past six years. The extraordinary abundance of the natural gas is only equalled by the reckless manner in which it has been wasted. It is already decreasing, and, in Professor Orton's opinion, should be reserved chiefly for domestic uses. An excellent review of the theories accounting for the occurrence of oil and gas is given. This report

Publications received at Editor's Office,
Feb. 16-21.

- ALUMINUM AGE. Vol. I. No. 1. m. Newport, Ky., C. L. Hartsfeld. 8 p. f°. 25 cents per year.
CALL, Annie Payson. Power Through Repose. Boston, Roberts. 169 p. 16°. \$1.
COTTERILL, J. H., and SLADE, J. H. Lessons in Applied Mechanics. London and New York, Macmillan. 512 p. 16°. \$1.25.
COUES, E. "A Woman in the Case" ("The Biogen Series," No. 6). Boston, Occult Publ. Co. 54 p. 24°.
GRAHAM, R. H. Geometry of Position. London and New York, Macmillan. 192 p. 12°. \$1.75.
GREENOUGH, J. B., ed. Livy. Books I. and II. Boston, Ginn. 270 p. 12°. \$1.35.
LINCOLN, D. F. Hygienic Physiology. Boston, Ginn. 206 p. 12°. 90 cents.
MASON, L. W., and VEAZIE, G. A., jun. The New Fourth Music Reader. Boston, Ginn. 282 p. 8°. \$1.05.
RECLUS, E. Primitive Folk. Studies in Comparative Ethnology. New York, Scribner & Welford. 339 p. 12°. \$1.25.
SHOEMAKER, J. V. Heredity, Health and Personal Beauty. Philadelphia and London, F. A. Davis. 422 p. 8°. \$2.50.
WARD, May Alden. Petrarch: a Sketch of his Life and Works. Boston, Roberts. 293 p. 12°. \$1.25.
YOUNG, C. A. Lessons in Astronomy. Boston, Ginn. 357 p. 12°. \$1.30.

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—The "Investigations of the New England Meteorological Society" for 1889, includes, besides the usual tabular summaries, three essays on "Weather-Types in New England," "The Sea-Breeze on the New England Coast," as observed in 1887, and the "Characteristics of the New England Climate." The greater part of these are contributed by the director, Professor W. M. Davis of Harvard College, and Professor W. Upton of Brown University. The essay on weather types opens a line of writing that might be taken up to advantage in other State weather services, where some addition to the monotony of the annual tabular reports would be refreshing. The study of the sea-breeze is based on the reports of about a hundred volunteer observers on and near the eastern coast of Massachusetts, from Newburyport to Plymouth. The irregularity of the occurrence of the breeze is so great that it does not appear a hopeful subject for further study. Professor Upton

summarizes the climate of New England under the following headings: changeable and unsettled weather; great ranges of temperature, both daily and annual; variation of seasons from year to year; equable distribution of temperature; and variety of local features from the low southern coast to the mountainous northern interior.

—In *Lippincott's Magazine* for March, 1891, the first instalment of "Some Familiar Letters by Horace Greeley" form an interesting feature. This is a series of letters written by Horace Greeley to an intimate friend, and covers the period immediately preceding and during his political campaign. These letters are expected to remove many unfounded prejudices. Another of the series of "Round-Robin Talks" appears in this number. Among the guests are Paul B. Du Chaillu, George W. Childs, T. P. Gill, M.P., George Parsons Lathrop, Julian Hawthorne, and others. The *pièce de résistance* of this instalment is the story told by Paul Du Chaillu of his discovery of the gorilla in the wilds of Africa.

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Presidential Address
Steps in our Knowledge of the Organic World.
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Aspect of the Heavens—January.
Half-an-Hour at the Microscope, with Mr. Tuffen West.
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